MEMORANDUM

To: Vermont Agency of Transportation
From: CDM Smith
Date: September 29, 2021
Subject: Flat Fee and MBUF System Definition

This memo includes recommendations from the consultant, CDM Smith, for consideration and discussion by the Vermont Agency of Transportation and the Road Usage Charge Advisory Committee and does not necessarily reflect the Agency's position or approved policies.

1. Introduction

The concept under evaluation is that Vermont drivers of electric vehicles and perhaps other highly fuel-efficient vehicles will have the option of paying a flat fee or a mileage-based user fee. This memo explains system design options and the policy options that impact systems design for vehicle flat fee/MBUF systems from the state perspectives. The explanations given here are based on research and pilot work by US states over the past 20 years, notably by Oregon, Washington, California, Utah, and Hawaii.

The memo begins by explaining the basic elements of MBUF system design, focusing on account management. Following that are discussions of policy options available to the state, technology options available to the state, and the operational processes needed to run the MBUF system from the state perspective. The memo then provides a range of costs for the most desirable system/policy configurations and then explains some forward-looking considerations for a flat fee/MBUF system. The memo concludes with high level recommendations for the state for next steps on flat fee/MBUF system design.

1.1 Detailed contents of this memo

Following this introduction, this memo contains the following sections:

2. Account Management, including the basic functions of a flat fee/MBUF system, and potential roles for state government and private industry
3. Policy topics that impact system design:
   a. Which vehicles may be covered by a flat fee/MBUF program
   b. MBUF/ flat fee rate considerations
   c. Refunds for vehicles without GPS reporting
   d. Privacy
   e. Degree of integration with existing systems

4. Mileage reporting options, including OBD-II plug-in devices, odometer image capture, native automaker telematics, smartphone aps, vehicle inspection based reporting and self-reporting
5. State government operational processes, such as implementing flat fees, and various MBUF/flat fee payer processes
6. Cost ranges of likely approaches
7. Potential future system needs
8. Recommendations

A synopsis is provided at the start of each section that highlights the specific observations and findings and identified the key decisions that need to be made.

2 Account Management

This section describes the highest-level activities in providing flat fee/MBUF service, which are typically called account management. This section highlights the roles that state government always plays, such as providing the vehicle registry, overseeing account managers, and providing final enforcement. It then discusses roles best filled by private vendors, including providing various technologies. Specifically, this section covers the following topics:

2.1 Account management basics
2.2 MBUF functions
2.3 Roles that state government always provides
2.4 Potential state roles in account management
2.5 Private industry roles
2.6 Flat Fee account management considerations

2.1 Account management basics

Synopsis

MBUF account management can have different structures. Operation of simple systems, like manual odometer reporting or flat fee collection, requires only in-house state account management (SAM). Operation of more sophisticated systems, like automated mileage reporting, typically requires private sector account management operated by commercial account managers (CAMs). Some states use multiple account managers in an open system to facilitate competition by allowing drivers to choose an account manager based on the services provided.

State government agencies provide account management oversight, program outreach, vehicle registry database, enforcement and overall program management. Private industry commonly provides technologies, mileage reporting services, accounting and customer service.

Decisions

1. Should Vermont implement a state operated system, or a private sector operated system with government oversight, or a hybrid system combining state operations for manual reporting and private sector operations for automated reporting?

2. Shall RUC operations have an open or closed system?

In MBUF pilots since the 2012 Oregon pilot, processing of mileage reporting data, payments, user account management, and customer service provision has been provided by an entity called an account manager. Unlike fuel taxes, MBUF requires an individual measurement of an individual vehicle, so an account for the given vehicle is necessary. This account has typically been a new account created by an account manager, but could also be an existing account, such as the account a DMV might already have for a given vehicle or owner.

MBUF account managers have typically been private companies called Commercial Account Managers (CAMs), but the state can also act as an account manager. Oregon includes one "State Account Manager" in addition to two private account managers.[1] In addition to the functions described above, Account Managers regularly send their data to the state's central MBUF data repository. Further, Account Managers act as the main touch point that vehicle

[1] The state account manager services are provided by a private company "white-labeled" as the state of Oregon.

owners have with the MBUF system. For that reason, it is vital that Account Mangers provide the best user experience possible. This includes user-friendly customer service, website, mobile app, and driving statement design.

The typical system architecture for account management of an MBUF is as follows:

In this architecture, each vehicle (manually or through mileage reporting technology) reports data with some frequency to the account manager (it may be daily or more frequently for high-tech options; it may be annual for low-tech options), and the account manager reports aggregated data (not including disaggregate location data) to the State MBUF accounting system with some frequency (typically monthly for high-tech options and annually for low tech options).

State systems, such as DMV registries, are typically not well suited for supporting more sophisticated mileage data collection technologies like OBD-II plug-in devices (see Section 4.3). Account managers can provide and support such technologies, although their services may be "white-labeled" as state services. By contrast, many states may be able to support less technically sophisticated means of mileage reporting, like self-reporting or reporting based on safety inspections.

Since the Oregon 2012 pilot, and even in the New Zealand RUC system before it, account management systems have been designed to be open systems: systems are defined in openly available specification documents and allow entrance by new market players. By contrast, closed systems–systems not specified by openly available documents, but rather proprietarily provided by a single vendor have the disadvantages of locking in one vendor, reducing price competition and halting innovation. Closed systems were used in early electronic tolling implementation with such predictable results.

As a step beyond open system, open markets allow new vendors to begin providing account management services in a state at any time, so long as they are certified to provide the systems in the open specification documents. This provides for regular ongoing competition among vendors, ideally lowering costs and improving service. Smaller MBUF systems, such as Utah's,

begin with procurement of just one vendor, but plan to grow as an open system as the MBUF user base grows.

2.2 MBUF functions

The following basic functions must be completed by any MBUF system:

1. **Identify subject vehicle and its owner/lessee**: utilizing the state vehicle registry, create a list of VINs of the vehicles subject to MBUF. Providing the vehicle registry is a role of state DMV or equivalent; the check can be performed by the state or a private entity.
2. **Generate distance traveled data for subject vehicle over designated time**—reporting mileage data on vehicles. This is a function of the account manager, which can either be the state or a private company.
3. **Access distance data**—this means receiving the reported mileage data from vehicles and storing it in an accounting system. This is a function of the account manager.
4. **Apply distance fee rates**—processing the mileage data to determine the amount of fees owed. This is a function of the account manager.
5. **Provide invoice to owner/lessee**—provide vehicle owner a notice of the fee owed. This is a function of the account manager.
6. **Collect payment**—support various payment options, including credit cards and in mandatory systems, cash. This is a function of the account manager, but not all account managers need to support all payment options. For example a state account manager may support cash payments, while private ones do not.
7. **Issue acknowledgement of payment**—provide receipts for payment. This is a function of the account manager.
8. **Enforce payment**—provide means of fraud detection and consequences to ensure most everyone pays. Fraud detection is a shared role of account managers and the state, but serious consequences (for serious fraud) is a role of the state.
9. **Remit revenue to appropriate fund**—this is a shared role of the account manager and the state. The account manager typically remits all funds to a single account, and the state treasury then routes those funds further as required by law.

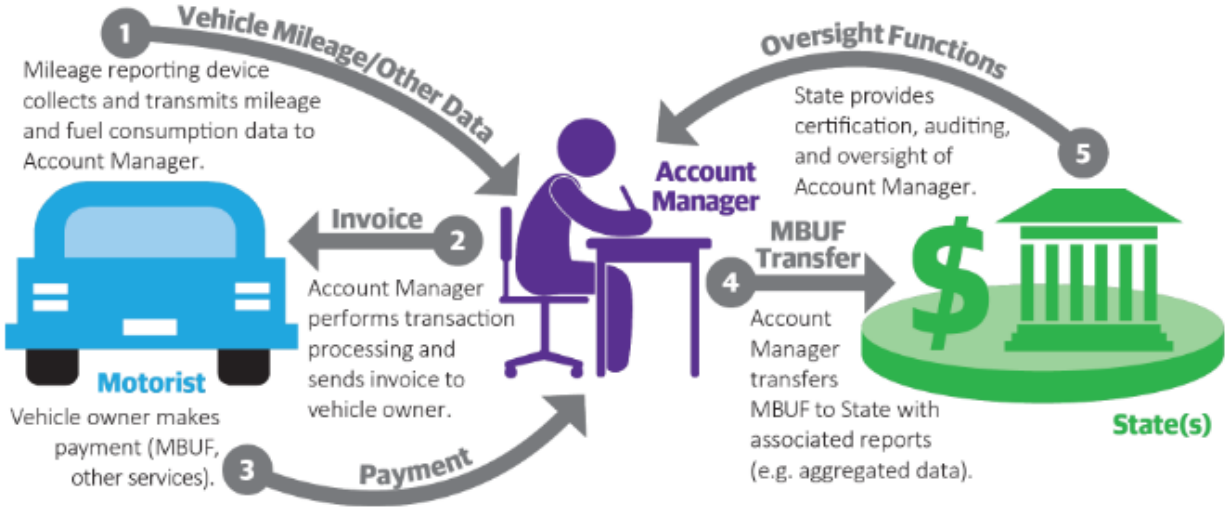
2.3 Roles that state government always provides

State government provides the following roles in MBUF systems:

- Account manager oversight—run the state MBUF accounting system and use it to monitor account manager data. Regularly validating that account managers are performing their duties of charging miles and remitting funds. Overseeing certification and audits of account managers.
- State-level program outreach—public education to ensure that vehicle owners are aware of and know how to respond to the MBUF/flat fee system.
- Provision of vehicle registry database—providing the base data needed to check that all vehicles are enrolled in the MBUF or flat fee program.

- High level enforcement and adjudication—providing penalty notices and more severe consequences, such as vehicle registration holds, in cases of significant fraud; and providing a means of appeal (adjudication) in cases in which suspected violators feel they have been incorrectly targeted.
- Overall program management—leadership of the MBUF/Flat Fee program.

Other roles in flat fee/MBUF provision may be provided by private industry or the state.



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2.4 Potential state roles in account management

There are three options for state role in account management:

1. The state can operate the entire system
2. The state can operate one or two mileage reporting methods (e.g., vehicle inspection based), and hire CAMs for the rest
3. The state can hire CAMs for all mileage reporting methods

In general, state governments are not optimized to provide high tech solutions that require hardware, significant software development, or constantly changing technology. Thus, state governments are not well-suited to operate OBD-II plug-in device MBUF systems, and would most likely purchase odometer image capture software, though the state could potentially provide the accounting system, or purchase the software from a vendor. In case of option 1 (state operation of the entire system), the state would most likely rely on a lower technology system, such as vehicle safety inspection. In the case of option 2 (hybrid), the state would offer the lower technology system such as vehicle safety inspection, while hiring one or more CAMs to provide plug-in devices and other technologies. In case of option 3 (fully outsourced), there is no state account manager—the state simply oversees one or more CAMs.

2.5 Roles for private industry

The following are roles commonly fulfilled by private companies in MBUF systems:

- Mileage reporting technology vendor—the company can provide the device and/or software. This role may be coupled with provision of account management services, but that is not necessary.
- Commercial Account Manager (CAM)—the company acts as CAM, including mileage reporting, accounting, and customer service for one or more mileage reporting methods.
- Audit/certification—an organization certifies and/or audits CAMs on behalf of the state. Technology audits may be provided by a technology auditor, such as Underwriter's Laboratories or OmniAir; financial audits would be provided by an accounting firm.

2.6 Flat fee account management considerations

The flat fee component of the flat fee/MBUF system can be handled by the state without technology or involvement by outside account managers. Most state vehicle registries, such as the one operated in Vermont by the Department of Motor Vehicles, already assess vehicle fees based on a variety of factors including age, weight, value, and other characteristics.

Adding a flat fee based on the vehicle's engine type (electric or plug-in hybrid electric) requires the DMV to know or find out the engine type of vehicles registering or renewing their registration. If this field of data is not already collected by DMV, it can be added to a robust system or built into the next system upgrade. Alternatively, DMV could use a Vehicle Identification Number (VIN) decoding service to determine vehicle engine type. VIN decoders have a relatively high match rate for light-duty vehicles (those under about 10,000 pounds), typically well above 90%. Difficulties include decoding older vehicles (pre 1983), vehicles with non-standard VINs, and incorrectly coded VINs (typos). Determining whether a vehicle is an electric or plug-in hybrid from the VIN will be accurate and straightforward.

Given that the flat fee/MBUF concept being evaluated requires vehicle owners to choose either the fee or the MBUF, the DMV system also requires the ability to indicate which fee approach the vehicle owner has chosen and monitor compliance. If the vehicle owner chooses the MBUF approach and the mileage reporting is operated in whole or in part by an entity other than DMV, then DMV's system will require the ability to send and receive data to and from the other entity regarding the vehicle's status. This can be accomplished through file exchanges or an online data interface (API).

3 Policy choices impacting system design

This section explains the following MBUF/Flat fee policy choices impacting system design:

1. Which vehicles may be covered by a flat fee/MBUF program
2. MBUF/ flat fee rate considerations
3. Refunds for out of state miles driven for vehicles without GPS reporting
4. Privacy
5. Degree of integration with existing systems

In general, these policy choices can be made without respect to the choice of mileage reporting technology.

3.1 Which vehicles may be covered by a flat fee/MBUF program

Synopsis

States commonly impose flat fees on all-electric vehicles (AEVs) and often plug-in hybrid vehicles (PHEVs) as well. Flat fees for conventional hybrids are less common. Oregon and Virginia impose flat fees on internal combustion engine (ICE) vehicles with above average fuel efficiencies. Flat fees are not proportional to road use.

Decisions

Which vehicles are covered?

- Electric vehicles and plug-in hybrid electric vehicles?
- All alternative fuel vehicles?
- Gasoline hybrids?
- High-mileage liquid fuel vehicles?
- All vehicles?

The vehicles most commonly covered by flat fee / MBUF programs are Electric Vehicles (EVs) and Plug-in hybrid electric vehicles (PHEVs), with fees for conventional hybrid vehicles being somewhat less common. The rationale for charging EVs and PHEVs is that they are not paying fuel taxes on the miles they drive and should therefore be charged in some manner for their roadway usage. The rationale for charging hybrids is less clear, because conventional hybrids already pay fuel tax on all miles driven but they use a special technology to obtain better fuel

[2] As explained below in Section 7, in the subsection on transition and growth of RUC programs, states that adopt the combination of flat fee and MBUF generally do not intend to keep this as their policy in the long term, but rather to eventually transition fully to an MBUF.

economy than other comparable vehicles. Oregon's ORe*GO* program allows EVs and PHEVs to avoid flat fees by paying MBUF,[3] while Utah's program includes hybrids as well as EVs and PHEVs. Some states, such as Utah, include other alternative fuel vehicles, such as vehicles running on compressed natural gas (CNG) or liquid propane gas (LPG) with electric vehicles in their flat fee / MBUF program.

Following EVs, PHEVs and hybrids, states are looking at charging high fuel efficiency internal combustion engine vehicles a flat fee or MBUF. Oregon, for example, charges vehicles between 20-39 mpg a $5 registration surcharge over those that get 19 or less mpg, and charges vehicles getting over 40 mpg a $15 surcharge over those that get 19 or less mpg.[4] Virginia charges all vehicles that get 25 mpg or greater a surcharge that varies with every 1 mpg increment. 25 mpg vehicles pay a $4 annual surcharge, which increases up to about $90 for fully electric vehicles.[5] Virginia charges all vehicles getting greater than average fuel economy a flat fee, while Oregon groups vehicles into four categories: <20 mpg, 20-39 mpg, >40 mpg, and EV/PHEV. Virginia's approach may seem fairest, as there is no arbitrary grouping of fuel economies (getting higher than average is an objective threshold, not an arbitrary one). However, it results in very small surcharges for a large number of vehicles, and once such vehicles are allowed to opt into MBUF payment, may cause the state to incur higher operational costs.

Other internal combustion engine vehicles—those getting average or lower fuel economy—could be phased into an MBUF later, after other vehicles are paying the MBUF, or they could be omitted from the program entirely, and simply allowed to continue paying the gas tax. If such vehicles were transitioned from the gas tax to the MBUF, they would pay less money than they do under the gas tax, should the MBUF rate be set to a value that is revenue neutral with the current gas tax. Thus, the state may choose to leave all vehicles getting less than a certain fuel economy on the gas tax for the foreseeable future. Eventually, vehicles with low fuel economy will retire from the fleet and be replaced by newer vehicles with high mpg or electric engines.

[3] ORe*GO* also allows these higher than average fuel economy internal combustion engine vehicles to enroll.
[4] Such vehicles cannot avoid paying these fees by paying the RUC in Oregon—only EVs and PHEVs can do so.
[5] Starting in July 2022, Virginia plans to offer an MBUF instead of these flat fees to owners of such vehicles.

3.2 MBUF/ flat fee rate considerations

Synopsis

Oregon, Utah, and Virginia allow AEV, PHEV and hybrid drivers to choose between paying a flat fee or a mileage-based user fee (MBUF).

Flat fees are typically assessed as part of the vehicle registration and renewal processes. The rates tend to vary by vehicle type. AEVs typically have the highest rate because they pay no fuel tax. PHEVs, hybrids, and high-efficiency ICE vehicles have lower rates because they do pay some fuel tax.

Mileage-based user fees are capped by the amount of the flat fee, thus limiting the amount of revenue an MBUF system can generate. Low caps induce lower amounts of revenue coming to the state while high caps increase it.

Decisions

1. Should Vermont allow payers of flat fee to opt in to MBUF?
2. Should Vermont cap the annual MBUF at the flat fee value or some multiplier of it?

Flat annual fees, whether implemented alone or in conjunction with an MBUF, are generally the simplest options to implement as state systems are already set up for recording registration fees paid. The state can also record vehicles that opt out of the flat fee and into the MBUF, whether or not the state provides the MBUF account management for that vehicle. The flat fee may vary by vehicle type (hybrid vs. PHEV vs. EV), or even by mpg rating (as Virginia does). EVs typically have the highest rate as they pay no fuel tax; PHEVs pay a lower rate as they may pay some fuel tax; hybrids and high-efficiency internal combustion engine vehicles pay a lower rate, if any at all. However, the flat fees are not proportional to roadway usage. Flat fees are generally charged at the time of vehicle registration / registration renewal. Thus, the period for which the fee is valid is usually the same as the vehicle's registration year (one year). This requirement to synchronize the payment validity with the registration year has a range of system design implications, such as the need to send reminders in sync with the vehicle's registration renewal.

An MBUF can be implemented as a voluntary program in parallel to the flat fee, in which users opt to pay the MBUF instead of the flat fee. In this case, the amount of MBUF paid can be capped at (limited to) the flat fee (which can be referred to as the "cap" and may vary by vehicle type). This arrangement removes any financial downside of opting into the MBUF

option for participants, which will increase MBUF participation, potentially making for a smoother transition to MBUF. However, offering such caps will limit revenue for the state, as those who might choose the MBUF but drive more than the number of miles equivalent to the cap will not pay for those miles in excess of the cap. Those who opt into the MBUF and drive less than the cap will pay only for those miles driven. Once the MBUF is established, the flat fee could be raised to encourage participants to choose the MBUF and to capture more revenue associated with miles driven above the cap.

3.3 Credits or refunds for vehicles without GPS reporting

Synopsis

State MBUF programs tend not to charge its residents for driving out of state. Resident drivers reporting mileage using location-aware devices are not charged for out of state miles driven. However, for vehicles without location-aware devices, states can offer standard exemptions or refunds with some proof for resident drivers electing not to use location-aware reporting.

Decisions

1. Should Vermont drivers without location-aware devices receive a standard exemption for miles driven off public roads or out of state, or receive a variable exemption based on registration location?
2. Should Vermont drivers without location-aware devices have the option of applying for refunds/credits for miles driven off public roads, or should there be no refunds?

In general, a state should charge for road usage only for the roads it builds and maintains—not for other states' roads. For vehicle owners who use mileage reporting with GPS location data, miles driven out of state, as well as off-road or on private roads, can simply be exempt from the MBUF calculation

However, many vehicle owners may not prefer to report GPS location data to the MBUF system. They may do so out of privacy concerns, or simply because they do not wish to pay extra costs that may be associated with GPS reporting. The state can choose among the following options:

- Offer a standard exemption—an amount equal to the average number of miles a resident drives out of state, say, 1,000 miles per year; that value would be deducted

from each vehicle owners' annual MBUF based on total miles driven documented during annual inspections, unless the owner used GPS reporting.

- Offer a variable exemption—the exemption indicated above could vary by location of vehicle registration to offer a higher exemption to vehicles located near state borders–for example, on a zip code or county basis.
- Offer credits or refunds for out of state, off-road, or private road miles driven. Credits or refunds generally should require some proof (e.g., receipts from fuel or food purchases on the dates of travel at the locations of travel) in order to prevent fraud. Processing refunds can be expensive, time-consuming, and inconvenient for both drivers and the agency responsible for processing them. Credits against other fees can be less costly than operating a refund process.
- Require GPS-based reporting in order to be eligible for exemption from non-chargeable miles.

3.4 Privacy

Synopsis

Privacy protections can be built in to an MBUF system through both policy choices and technical requirements. States can offer non-location aware mileage reporting options and guarantee privacy protection rights in law. A privacy law can require destruction of location data after a designated period and prohibit use of data aside from MBUF without express user permission.

The primary technical means of ensuring privacy is through enacting robust data security measures, requiring that every actor in the MBUF system—both the state and private vendors, have robust Information technology security practices.

Decisions

Should Vermont guarantee privacy rights in law?
Should Vermont offer non-location-based mileage reporting?
Should Vermont require private companies to process location data rather than the state government?

Privacy is a common concern in implementing an MBUF system, often due to the misperception that MBUF requires GPS tracking. Privacy protections can be built in to an MBUF system through both policy choices and technical requirements, and both are necessary to offer the robust privacy protection needed to reassure the public.

Policy choices to ensure privacy include:

- offering non-location based MBUF reporting options,
- requiring private companies process location data for those customers opting to report location data for mileage exemptions,
- guaranteeing privacy rights in law, and
- offering further privacy rights in user agreements.

Even with the most robust privacy protections, some users will not want to have their location data recorded in any way. This observation led to the policy decision in Oregon that for these users, some form of non-location-based mileage reporting should be offered. This feature led to the success of Oregon's 2012 RUC pilot, and all subsequent MBUF efforts in the U.S. have provided at least one non-location-based means of paying. While there may eventually come a time when location-based reporting is accepted by nearly all vehicle owners, at least one non-location-based method (which may include a flat fee) should be offered in Vermont's MBUF program.

A further protection of privacy in policy is offered by requiring only private companies, not the government itself, to process all location data. Many individuals are most concerned about the government having access to their location data and are more comfortable with a private company processing such data, and providing only aggregated data (e.g., miles by state) to the government.

A third protection of privacy in policy is to enact privacy rights in law, either in a state privacy rights law or directly in the MBUF-enabling legislation. This law should contain the following provisions:

- Destruction of location data—all location data should be destroyed after some number of days (30 in Oregon, but 45 may be reasonable), except in cases of dispute, unless the user opts out of this destruction.
- No use of data aside from RUC without express user permission. Alternatively, the law may allow for the use of aggregated, anonymized data for system optimization and transportation planning purposes. Anonymization means removal of all personally identifiable information, including the location of the first and last ½ mile driven for individual vehicle trips.

A final protection of privacy in policy is to encourage user agreements by all private firms handling location data. These agreements should recap the legal rights and provide any additional rights that Account Managers might want to provide. The user agreement may also

allow vehicles owners to opt out of the location data destruction requirement in law, so that the private firm can offer services that take advantage of the user's location data.

The primary technical means of ensuring privacy is through enacting robust data security measures. Doing so means that every actor in the MBUF system—both the state and private vendors, have robust Information Technology security practices, including:

- Firewall and intrusion detection
- Anti-malware
- Authentication (robust username/password)
- Encryption at rest and in transfer

In addition to the data security requirements described above, the technical implementation of privacy includes implementing the policy measures. This means, at a minimum, that all location data should be destroyed as indicated in law.

3.5 Degree of integration with existing systems

MBUF systems can have varying degrees of integration with existing state systems. They may be separate, with little integration beyond providing summary data to the state (in the current ORe*GO* system, the CAMs provide all RUC service). Alternatively, as in Utah, CAMs may be integrated with the DMV for enrollment, de-enrollment, and in cases of fraud/delinquency (exchanging data in each of these cases). Finally, a state-run AM could be fully integrated into the state's IT system. Full integration would likely only make sense for a larger program and in cases in which the integration could be accomplished at the time of a DMV refresh.

4 Mileage Reporting Technologies

Synopsis

States approve mileage reporting technologies. The commonly used mileage reporting technologies include,

- *OBD-II plug-in devices* plug into vehicle data ports. Some can use GPS technology to enable location-based mileage reporting, while others simply count total distance. OBD-II devices with GPS are the only currently viable technology for excluding miles driven out-of-state or on private roads from paying the per-mile fee.
- *Odometer image capture* uses smartphones or tablets with cameras to take odometer image for submission to an account manager.
- *Native automaker telematics* uses data from connected vehicle systems built into newer vehicles to compute the mileage-based user fee. Currently, automakers do not directly support this method, leaving it to third party providers.
- *Smartphone apps* can record and report distance traveled data but the experience lacks a link to the vehicle and thus does not create a truly seamless experience.
- *Vehicle inspection* uses odometer mileage data recorded at regular vehicle safety inspections.
- *Self-reporting* allows vehicle owners to report their vehicle's odometer.

Decisions

Which mileage reporting method should the MBUF program offer?

- Use of data reported at annual vehicle inspection?
- Self-reporting?
- ODB-II plug-in devices (with or without GPS)?
- Odometer image capture?
- Native automaker telematics?
- Smartphone app?

The state will generally need to approve mileage reporting technologies, even if they are only offered by a private vendor. This section describes the following common mileage reporting technologies:

4.1 Vehicle inspection
4.2 Self-reporting
4.3 OBD-II plug-in device
4.4 Odometer image capture
4.5 Native automaker telematics
4.6 Smartphone app

4.1 Vehicle inspection

Vehicle inspection means using data recorded at regular vehicle safety inspections to compute MBUF owed. Vermont is one of thirteen states that requires an annual vehicle safety inspection, and this transaction offers an ideal way for many residents to report miles traveled, as no additional activity on their part is required. This method of data reporting was recently trialed in Hawaii, where over 360,000 notional annual driving statements were sent to residents, who generally gave the system positive remarks based on survey responses. A pilot of this sort in Vermont may be useful if targeted at the approximately 4,000 AEV owners.

Vehicle inspection has some limitations. The data is currently manually keyed in by vehicle inspectors, meaning there may be date entry errors, but this could in the future be replaced by odometer image capture on the inspectors' tablets. In cases of erroneous data, users would need the opportunity to correct it. Further, vehicle inspection does not capture odometer readings at the time of vehicle sales or moving in or out of state. In instances of sales, the state could simply require the new vehicle owner to be responsible for all miles driven or access the odometer readings in the ownership transfer document submitted to DMV. To address the issue of moving out of state, the state could require submission of an odometer image capture or self-reporting, or could require the MBUF system to be pre-paid. Vehicle inspection-based reporting could also be supplemented by other methods such as OBD-II plug-in device reporting, for those individuals that wish to report location data.

4.2 Self-reporting

Self-reporting means that vehicle owners can simply report their own odometers at times of MBUF payment. Given that Vermont has annual inspections, which can serve as an annual true-up, there should be less concern about self-reporting fraud. Like other taxes based on self-reporting, audits can help deter fraud. Audits could be done through vehicle inspection, through a requirement to submit an odometer image, or simply through combining self-

reported data with safety inspection data. When a vehicle owner submits an odometer mileage value lower than the value reported at their most recent safety inspection, the odometer value could simply be updated to the value at the last safety check, or the vehicle owner could be required to come to a DMV location to have their vehicle checked. Self-reporting is easily integrated with the registration and registration renewal processes—vehicle owners can simply be required to submit odometer readings at those times.

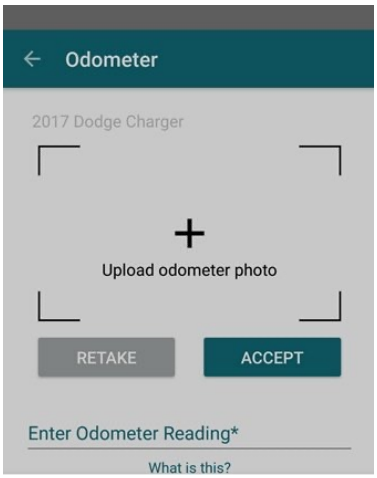
4.3 OBD-II plug-in device

OBD-II plug-in devices are small devices which plug into vehicle data ports, which have been manufactured into all light vehicles sold in the US since 1996, except the Tesla 3 and Y models. These devices are typically used to support the provision of mileage-based Insurance and light vehicle fleet management and are thus already in widespread production. Most such devices include cellular modems and GPS location technology, although devices are also available that use Bluetooth instead of cellular communications (relying on a user's cell phone for long-distance communications) and that do not include GPS technology. OBD-II devices with GPS technology are currently the only viable technology for charging based on location, for example, for charging for in-state miles only, or even for omitting miles traveled off-road or on private roads.

OBD-II devices with cellular modems for use in RUC programs cost about $100/device today, but at scale (several hundred thousand devices or more) could cost as little as $50/device. Providing cellular communications for each device can cost about $2/month/device today but may drop to $1/month/device in the coming years. Devices with Bluetooth instead of cellular will cost less, perhaps as little as $25/device, and have no communications costs, as they use a driver's cellular phone for long-distance communications.

Cell Coverage in Vermont. OBD-II devices can function in areas where cellular network coverage is limited or poor. Most OBD-II devices are designed to store data collected (buffering technique) until the device connects to the cellular network again to send the data.

4.4 Odometer image capture



Odometer image capture means using mobile devices with cameras (smartphones or tablets) to take an odometer image and submit it to the account manager. Image reporting is required at a specified frequency (e.g., quarterly, biannual, or annual). Odometer image capture can be used on-demand. If used for regular reporting, the state must send vehicle owners reminders, primarily by text message, and some users still will not comply (meaning not submit a valid image).

Odometer image software includes a range of security measures to prevent or detect fraudulent images, including requiring images be submitted live from the app (not allowing historical image submission), and software to detect image manipulation, either through software like Photoshop, or manual manipulation (taking pictures of printed pictures).

4.5 Native Automaker Telematics

Native automaker telematics means using data from connected vehicle systems built into the great majority of new vehicles to compute MBUF. As of the writing of this document, no automakers are directly supporting MBUF computations from native automaker telematics, but they are making native automaker telematics data available via third party API providers (including *smartcar* and *otonomo*). To use such a service, the vehicle owner provides the Commercial Account Manager their telematics login information (username and password), and the CAM then pulls vehicle odometer and possibly location data from the vehicle on a set frequency.

The maximum frequency for pulling that data varies by automaker—some, like Tesla, offer data pulls every minute, while others only allow data pulls every hour. Even with Tesla, when the vehicle is off, the data pulls can only be performed very infrequently (every few hours) to avoid battery drain. Thus, location data from such services is imprecise, and will not provide accurate

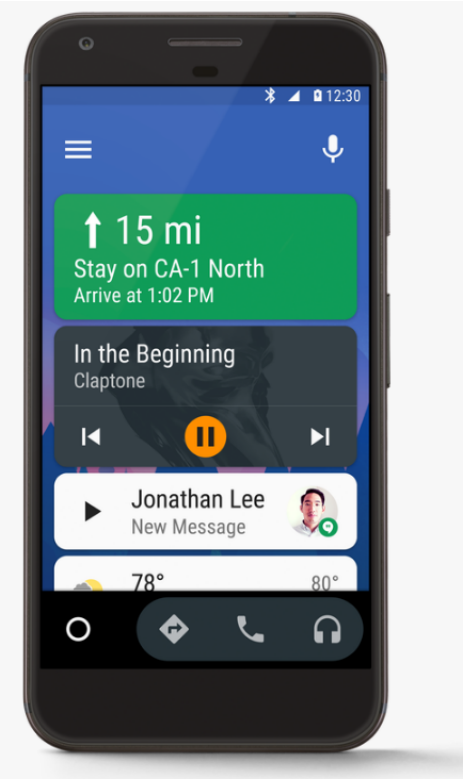
miles by state. Pricing for such services varies, but at scale should currently be around $2/month/vehicle (excluding any additional costs charged by the CAM).

Support of OEM telematics directly by the automaker will allow for precise location information for RUC computations, and future developments by automakers could even allow the third-party API services to get such information. Once this development occurs, this technology may be optimal for MBUF collection, as it is precise and requires no equipment in the vehicle. However, many vehicles are not appropriately supported by this technology yet.

4.6 Smartphone app

Smartphone apps that use location have long been proposed as a desirable way to record and report distance data for MBUF programs. However, to date, no app that is ready for revenue operations has been developed. Specifically, apps to date have lacked:

- A truly seamless user experience
- A link to a vehicle that identifies with high certainty when the app is in the specific subject vehicle and when it is not



People forget, lose phones, buy new phones, and let batteries die frequently—one can never be certain that a phone will be in a vehicle and connected at all times. Thus, such apps must be combined with odometer image capture, to cover miles driven when the phone is not in the vehicle.

An app with a reliable vehicle link and seamless user experience for MBUF reporting may yet be developed.

5 State government operational processes

While section 2 introduces account management generally, this section describes operational processes that state governments must support to involved to administer a flat fee/ MBUF system:

5.1 Payment options
5.2 Implementing flat fees
5.3 Account management processes that must be integrated with state systems
5.4 State government accounting processes
5.5 Enforcement and adjudication

5.1 Payment options

Synopsis

States decide payment methods and payment timing. Payment channels include credit card, debit card, automated clearinghouse (ACH), check, or cash. Payment timing options include prepay and post-pay.

Decisions

Should the MBUF program offer pre-pay (like the gas tax) or post-pay (like public utilities) or a choice?

The main payment decisions that the implementing agency needs to make when designing an MBUF system is the choice of payment methods and payment timing.

Payment methods include credit card, debit card, automated clearinghouse (ACH), check, or cash. Cards can easily be taken online. Thus far, MBUF programs have used bank card payment exclusively. However, if programs are mandatory, it will be necessary to accept cash payments, as nearly 10% of the population is unbanked. Unbanked individuals can purchase prepaid payment cards, but the cost of such cards has negative implications for lower income individuals. As a lower cost way of accepting cash payments, states could accept cash payments at DMV locations. Finally, the state could engage with payment networks like Blackhawk card services or PayNearMe which have contracts with local convenience and grocery stores and can accept payments at retailer registers.

Payment timing options include prepay and post-pay. Fuel taxes are prepaid in relatively small amounts whenever fuel is purchased and have the advantage that users must effectively pay the tax (when they purchase fuel) before they can use the roads. However, MBUF may mean prepay annually, a much on-time larger sum than would be involved in fuel taxes paid incrementally over the year. In the context of MBUF, prepayment usually means truing up at end of the year (adjusting for actual miles driven, as compared with the forecasted miles used in computing the prepayment). States may also wish to offer installment payment, to prevent large bills from burdening lower income vehicle owners. For mileage reporting options that report regularly, such as OBD-II plug-in devices, RUC systems may employ electronic wallets, such as those used on tolling systems, which can be withdrawn from gradually as miles are driven and are topped up when they drop below a given threshold.

Post-payment means payment as is common with utilities. If post-payment is used with MBUF, the state could consider requiring post-pay customers to make a deposit in order to use post-pay (instead of pre-paying, which would be deposit-free). The reason for requiring a deposit would be that a vehicle could move out of state, and if the state that the vehicle owner moves

to has no bilateral enforcement agreement with Vermont, the vehicle owner could not be compelled to pay his/her final invoice. If the invoice covers a full year, the value could be $200 or more, and a deposit would cover most losses incurred from such behavior. Traditional utilities also often require deposits for this reason.

5.2 Enrollment and withdrawal processes that must be integrated with state systems

Synopsis

If the state offers mileage reporting options other than odometer-based reporting, vehicle owners must enroll with an account manager. There are two account management processes: vehicle enrollment and withdrawal.

If the state offers purely odometer-based reporting (via self-reporting, vehicle inspection, and/or odometer image capture), no account management is required.

If the state offers mileage reporting options other than odometer-based reporting, vehicle owners must enroll with an account manager. In this instance, there are two account management processes that must be integrated with state systems: vehicle enrollment and withdrawal. If the state offers purely odometer-based reporting (via self-reporting, vehicle inspection, and/or odometer image capture), an enrollment process is not required. The existing DMV fee system can be modified to include new vehicle fees based on distance reported directly to it.

Vehicle enrollment means entering the vehicle in the system to record MBUF. Enrollment is generally possible at any time during the year, but if MBUF is charged in place of flat fees, those fees are typically paid up until the time of vehicle registration renewal. Thus, if a vehicle owner enrolls in the MBUF prior to vehicle registration renewal, the vehicle may not be charged MBUF until the new registration year starts. Special processes may be needed for enrolling vehicles purchased from dealers. It may be useful to record an odometer reading at the time of vehicle enrollment, even for mileage reporting technologies that charge mileage incrementally, such as OBD-II plug-in devices.

Vehicle withdrawal occurs for a variety of reasons (moving out of state, vehicle sales, vehicle scrapping, and even vehicle abandonment). In cases of vehicle withdrawal, the state must record that the vehicle is no longer enrolled in the MBUF program (and possibly no longer present in the state). In many cases it will also be advantageous to record the vehicle's final odometer value in order to charge the correct MBUF to the vehicle owner.

5.3 State government accounting processes

Synopsis

There are two state government processes for flat fee and MBUF programs: determining subject vehicles and account manager oversight.

For a mandatory program, determining subject vehicles means checking the state vehicle registry for vehicles required in the program. For a voluntary program, it means checking the vehicle registry for vehicles enrolled in the program.

Accounting and CAM oversight means that the state keeps accounting records for all vehicles in the state, including miles driven and charges paid.

There are two state government accounting processes involved in MBUF/flat fee programs:

- Determining subject vehicles
- Accounting and Commercial Account Manager oversight

Determining subject vehicles means checking whether any vehicle is subject to the MBUF/flat fee program. For mandatory programs, the state can use the vehicle registry to determine whether each vehicle is subject to the MBUF/flat fee upon vehicle registration or renewal, based on the vehicle's engine type or VIN. The state needs to notify owners of subject vehicles, which can be done at registration or during the registration renewal process (in person or online), by mail (with a registration renewal notice), or by email. For voluntary (opt-in) programs, the state need not check all vehicles, but only the vehicles whose owners choose to enroll in the MBUF program (this is the approach Utah is currently taking).

Accounting and CAM oversight means that the state keeps accounting records for all vehicles in the state, including miles driven and charges paid. CAMs are typically required to report these values to the state MBUF accounting system periodically (typically once a month), or if the state itself is an account manager, it can record these values directly. This is done to ensure that all account managers are providing the correct funds to the state.

Beyond the ongoing oversight of CAMs that takes place in accounting, states are typically involved in checking the CAM in initial testing or certification, and ongoing CAM auditing. Initial testing and certification involve checking that the CAM meets all technical requirements set by the state. It is typically done by consultants, but as MBUF programs grow, such testing may be carried out by certification bodies such as Underwriters Laboratories or OmniAir. Ongoing CAM auditing means checking whether operating CAMs continue to comply with technical and

financial rules. This can involve a typical financial audit, or a detailed technical audit of ongoing operations.

5.4 Enforcement and adjudication

Synopsis

State governments typically provide enforcement and adjudication for MBUF/flat fee programs. States are generally responsible for detecting failure to register vehicles directly, while the other types of evasion are detected by the account manager. The state is generally responsible for all enforcement consequences.

States governments typically provide enforcement and adjudication for MBUF/flat fee programs.

Fundamentally, the system should be designed and operated with a focus on evasion prevention:

- The system should be easy to use for all subject vehicle owners
- The public should be educated about the system, so they know how to comply
- The system should include good, easily accessible customer service
- The system should be designed to support all potential use cases—moving out of state, purchase from dealer, private purchases, etc.
- The public should know that fraud attempts will be detected and penalties will follow

Types of evasion to detect include general evasion (failure to register vehicle (locally), late payment, or moving away without making final payment), or mileage reporting method specific evasion (odometer rollback[6], unplugging mileage reporting devices, or odometer image fraud such as taking pictures of pictures). States are generally responsible for detecting failure to register vehicles directly, while the other types of evasion are detected by the account manager (which as discussed may or may not be a state body). Beyond detection by account managers, the state can audit vehicles suspected of fraud, either by comparing mileage values with odometer readings recorded at safety inspections, or by looking up odometer readings from third party services such as CARFAX.

The state is generally responsible for all enforcement consequences. Initial consequences for minor infractions may include a warning letter or a penalty fine. Significant consequences for prolonged or high-value violations may include registration holds, which should provide a

[6] Odometer rollback is possibly not only with mechanical odometers, but also with most digital odometers—the type used on all vehicles for the past 20 years. For a few new vehicles, such as Teslas, digital odometer rollback is virtually impossible, but for most it is possible. Odometer rollback is already a federal crime punishable by fines and jail time.

backstop in case of serious violations. Other significant consequences may include the use of collections agencies, or even wage garnishment.

The state should provide a means of disputing violations, called adjudication, in order to prevent the courts from being overwhelmed with lawsuits. Such adjudication may be similar to the process used by many cities for parking ticket disputes. While a few adjudicated cases may still be appealed to the court system, providing a robust adjudication process should keep the additional burden to the court system at a minimum.

6 Relative system cost estimates for five operating scenarios

This section describes cost estimates for five logical and desirable MBUF program operating scenarios. To do that, the section first describes a range of program choices and operating assumptions that impact the way the costs estimates are created. Then, the section describes the three MBUF reporting paradigms—each scenario employs one MBUF reporting paradigm. Finally, the section describes the cost estimates for the five operating scenarios.

6.1 Program choices and cost estimating assumptions

Synopsis

The cost of operating a flat fee/MBUF system depends on policy and operational program choices, such as:

- *Rate setting*. The relative rates at which the flat fee is set will impact the choice drivers will make between the flat fee and the mileage-based user fee. For example, if the flat fee is equal to the amount that the median vehicle would pay in MBUF, then we would expect half of vehicles to choose MBUF and the other half to choose the flat fee. Those choosing MBUF would be the 50% who reason to save money by driving less than average and, therefore, saving money compared to the flat fee.
- *Mileage reporting methods*, including how many and which methods to offer. Relying upon existing DMV vehicle inspection and odometer mileage collection process will be low-cost to implement, whereas relying on automated technology for mileage reporting would be more costly. A hybrid approach would fall in between.
- *Vendor service fees*. Should the state choose to offer automated mileage reporting, the state must also decide who will pay for it. The state could allow third-party vendors providing mileage collection services to charge customers directly for the service of measuring and collecting MBUF, or the state could subsidize some or all of the cost.

Decisions

1. Should the flat fee rate be set at the average of mileage-based user fees or higher?
2. Should the MBUF program offer a manual mileage reporting method, automatic mileage reporting methods, or a choice?
3. If the MBUF program offers automated reporting, who should pay for it–the state or those opting for automated reporting?

The cost of operating a flat fee/MBUF system depends on a wide range of policy and operational program choices yet to be made. This section summarizes several illustrative examples of costs and their dependencies to inform future decision-making.

The first program choice that impacts system costs is a policy decision: *rate-setting*, particularly the relative costs of the flat fee compared to the MBUF for Vermont electric vehicle owners. The relative rates directly impact the choice that drivers will make between the flat fee and the

MBUF. Using a purely rational choice model, vehicle owners would always choose the option that they perceive to have the lowest cost to them. For example, if the flat fee is equal to the amount that the median vehicle would pay in MBUF, then we would expect half of vehicles to choose MBUF and the other half to choose the flat fee. Those choosing MBUF would be the 50% who reason to save money by driving less than average and, therefore, saving money compared to the flat fee. Those choosing the flat fee would be the other 50% who reason to save money by driving more than average and, therefore, saving money compared to the MBUF. If the flat fee is set relatively high, then we could expect over half to choose MBUF. The customer's choice, however, is not purely rational. Some drivers will choose the flat fee for perceived convenience regardless of expected savings, while some will choose the MBUF out of interest. Many people will make a random choice either due to misunderstanding or a lack of interest or attention to their optimal calculation (most people do not act in an economically rational fashion). For cost estimating purposes, the choice people make matters: flat fees will be less costly to collect than MBUF because they represent a fairly simple surcharge during the routine vehicle registration or renewal transaction.

The second program choice that impacts system costs is also a policy decision*: mileage reporting methods*, including how many and which methods to offer. An approach that depends purely on the existing DMV vehicle inspection and odometer mileage collection process will be relatively simple and low-cost to implement, whereas an approach that depends purely on automated technology for mileage reporting would be relatively more costly. The cost of a hybrid approach, allowing customers to choose between default inspection-based odometer mileage as the basis for MBUF versus opting into an automated reporting approach, would fall somewhere in between.

The third program choice that impacts system costs is a further policy decision: *whether to allow third-party vendors* offering automated mileage reporting methods to collect service fees directly from customers. Should the state choose to offer automated mileage reporting, either as the only option or as an alternative to the default inspection-based odometer mileage, the state must also decide who will pay for it. The state could allow third-party vendors providing mileage collection services to charge customers directly for the service of measuring and collecting MBUF, along with whatever package of other commercial services they offer. Or the state could subsidize some or all of the cost. In early pilot programs in Oregon and Utah, the state pays for the entire cost through contracts with vendors, but the longer-term vision in both states is to transition to a model where at least a share of the costs is borne by customers either directly or indirectly. For example, vendors can provide and charge them for ancillary services unrelated to MBUF—mileage-based insurance, [7]geo-fencing, targeted travel information—that also cover the costs of providing the MBUF service.

[7] Geo-fencing is the practice of using global positioning (GPS), Wi-Fi, cellular data, or radio frequency identification (RFID) to define a virtual geographic boundary known as a geo-fence.

The remaining program choices that impact system costs are largely *operational decisions* and would be made by the implementing agency, likely DMV. For example, the agency must decide when and how to collect the fee. We assume the flat fee would be collected at the same time as vehicle registration and renewal. We further assume that MBUF would be collected along with vehicle registration and renewal for those opting for inspection-based odometer mileage reporting. Should the state allow third-party automated mileage reporting, we assume that the vendor and the vehicle owner would determine the payment frequency and methods, but that the vendor would supply batch payments to the state at least monthly on behalf of its customers. In addition, the agency must decide payment methods. We assume payment methods would be the same as those available for vehicle registration transactions and, therefore, the cost profile of transactions would follow a similar pattern.

In addition to transaction-related decisions, the agency may desire to provide upfront information to vehicles subject to the new flat fee/MBUF program, for example via direct mail, general advertising, social media, and the agency website. These communication activities will come with at least one-time costs. The additional queries related to the new fees will generate additional customer service inquiries including longer transaction times initially to help customers make the choice between the flat fee and MBUF (and the choice between odometer-based mileage reporting and automated reporting, if offered), facilitating enrollment with a third-party vendor for automated reporting (if offered), and facilitating off-boarding transactions that involve unpaid or pre-paid flat fees or MBUF when vehicles change ownership or leave the state. For purposes of estimating these costs, we assume a general increase in DMV staffing levels proportional to the relative number of vehicles subject to the flat fee/MBUF for the first ten years of the program. After that, we assume that staffing increases relating exclusively to the flat fee/MBUF will not be needed as Vermonters grow familiar with the program. Many other detailed decisions related to program design, the customer journey (the frequency and nature of customer touchpoints with the agency) will be required, but to simplify the number of cost scenarios presented, we do not delve into these assumptions at this early stage of flat fee/MBUF exploration.

Although DMV does not measure costs per transaction but based on data reported by the agency in budget documents, it is possible to estimate an approximate cost. The department's operations division constitutes approximately 70% of the department's FTEs. That division deals with vehicle transactions, driver licensing, motor carriers (IFTA and IRP), and fuel tax. We assume about 40% of that scope is vehicle transactions, and further, that 75% of vehicle transactions relate to passenger car registrations. In all, the agency devotes about 20% of its FTEs to processing vehicle transactions. Further, we presume that the costs associated with customer service operations are slightly lower than average for the DMV relative to safety, finance, administration, and executive divisions. Based on the agency's total annual budget of about $31 million and approximately 600,000 vehicle-related transactions, we estimate vehicle transaction costs in the range of $7-10. This includes the time of customer service agents to process transactions, fringe benefits associated with their labor, equipment and other overhead costs, credit card fees, and payment processing. The costs surely vary by type of transaction. For example, online renewals likely cost much less than in-person renewals, in the range of $3-5

per transaction (largely credit card fees, which range up to approximately 3% of the value of a transaction since 2018 have been borne by DMV).

For all vehicles subject to the flat fee/MBUF, we assume a 25% increase in vehicle-related transaction costs to cover the time and materials associated with handling customer queries and assisting with decision making for those who have not already decided based on information provided via mailers or the DMV website.

For the flat fee, we assume that 50% of customers will pay via credit or debit card and 50% will pay via other means. We assume the additional cost of a flat fee transaction will include the additional credit card processing fees for 50% of customers who choose to pay by card. For the other 50%, we assume no increase in processing costs.

6.2 MBUF reporting paradigms

Synopsis

There are three MBUF reporting paradigms for estimating costs:

1. The state only offers odometer reporting.
2. The state offers only automated mileage reporting.
3. The state offers a hybrid between odometer and automated reporting.

In the cost estimates below, we consider three MBUF reporting paradigms:

- In the Odometer paradigm, we assume the state only offers an odometer mileage method of reporting miles for MBUF purposes. In this paradigm, we assume 50% of customers will pay via credit or debit card, with the additional card fees associated with those customer payments. We assume no further additional transaction costs, as the fee calculation and presentation to the customer can be automated and included on the statement of registration renewal charges along with other fees.
- In the Hybrid paradigm, we assume the state offers an odometer mileage method of reporting and a commercial option for automated mileage reporting. Under the automated option, customers are eligible for exemptions for miles driven off road or out of state. In this paradigm, we assume 20% of customers opt for the automated method. We assume an additional initial transaction cost of $5 to assist with the transfer of customers from DMV to a third-party. All other costs are related to the third-party.
- In the Automated paradigm, we assume the state only offers the commercial option for automated mileage reporting. We assume an additional transaction cost of $5 to assist with the transfer of customers from DMV to a third-party. All other costs are related to the third-party.

6.3 Costs of five MBUF program operating scenarios

Synopsis

This section provides cost estimates relative to gross revenues for five operating scenarios. Each presumes a per-mile MBUF rate of 1.2 cents. As these scenarios illustrate, the major driving cost is the number of vehicles choosing automated reporting.

- Scenario 1 (hybrid): Assuming a flat fee 1.5 times the average value paid in MBUF ($209 per year flat fee), 83% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be $270,000, or 15% of revenue.
- Scenario 2 (odometer): Assuming a flat fee of double the average value paid in MBUF ($278 per year flat fee), 97% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be $136,000, or 6% of revenue.
- Scenario 3 (odometer): Assuming a flat fee equal to the average value paid in MBUF ($139 per year), 50% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be $92,000, or 6% of revenue.
- Scenario 4 (hybrid): Assuming a flat fee equal to the average value paid in MBUF ($139 per year), 50% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be $316,000, or 20% of revenue.
- Scenario 5 (automated): Assuming a flat fee of 1.5 times the average value paid in MBUF ($209 per year flat fee), 83% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be $483,000, or 25% of revenue.

Below are program cost estimates relative to gross revenues for five operating scenarios. For all scenarios we assume the following:

- A per mile MBUF of 1.2 cents
- An average of 11,600 miles driven per vehicle
- A program start year (“year one”) of 2024
- A moderate pace of EV adoption including 40% year-over-year growth in EV registrations over the next several years, resulting in approximately 15,000 registered EVs in Vermont in 2024 (year one of the program).
- Credit card transaction fees of 2.75%. We assume the flat fee varies in each scenario, which results in gross revenues that vary across the scenarios.

Operating scenario 1. In this scenario we assume a flat fee equal to 150% of the average MBUF amount paid, which leads to most drivers choosing the MBUF option. We assume the state offers odometer mileage reporting or automated reporting, but that 80% choose odometer mileage reporting. We assume the state covers 100% of the annual cost of the automated reporting which equals $60 per year.

Cost factor	Assumption
Flat fee amount	150% the average value paid in MBUF, or $209 per year
% choosing MBUF	83% choose MBUF over flat fee
MBUF paradigm	Hybrid
% choosing odometer MBUF	80%
Automated annual cost	$60
% automated cost paid by state	100%

Based on these assumptions, the cost to operate the flat fee/MBUF program in year 1 is about $270k covering 15,000 subject vehicles. This represents 15% of program revenue. By year 2030, costs will rise to just over $1 million, representing 12% of program revenue. By year 2040, costs will rise to just under $3 million, representing 10% of program revenue.

Operating scenario 2. In this scenario we assume a flat fee double the average MBUF amount paid, which leads nearly all drivers to choose the MBUF option (97%). We assume the state only offers odometer mileage reporting.

Cost factor	Assumption
Flat fee amount	200% the average value paid in MBUF, or $278 per year
% choosing MBUF	97% choose MBUF over flat fee
MBUF paradigm	Odometer
% choosing odometer MBUF	100%
Automated annual cost	N/A
% automated cost paid by state	N/A

Based on these assumptions, the cost to operate the flat fee/MBUF program in year 1 is about $136k, or 6% of program revenue. By 2030, costs rise to $366k or 4% of program revenue. By 2040, costs rise to $550k but represent only 2% of program revenue.

Operating scenario 3. In this scenario we assume a flat fee equal to the average MBUF amount paid, which leads half of drivers to choose the flat fee option. We assume the state only offers odometer mileage reporting.

Cost factor	Assumption

Flat fee amount	Equal to the average value paid in MBUF, or $139 per year
% choosing MBUF	50% choose MBUF over flat fee
MBUF paradigm	Odometer
% choosing odometer MBUF	100%
Automated annual cost	N/A
% automated cost paid by state	N/A

Based on these assumptions, the cost to operate the flat fee/MBUF program in year 1 is about $92k, or 6% of program revenue. By 2030, costs rise to $293 or 4% of program revenue. By 2040, costs rise to $392k but represent only 1% of program revenue.

Operating scenario 4. In this scenario we assume a flat fee equal to the average MBUF amount paid, which leads half of drivers to choose the flat fee option. We assume the state offers a hybrid mileage reporting approach and that 60% of drivers choose the CAM option, fully paid by the state at $50 per year.

Cost factor	Assumption
Flat fee amount	Equal to the average value paid in MBUF, or $139 per year
% choosing MBUF	50% choose MBUF over flat fee
MBUF paradigm	Hybrid
% choosing odometer MBUF	50%
Automated annual cost	$50
% automated cost paid by state	100%

Based on these assumptions, the cost to operate the flat fee/MBUF program in year 1 is about $316k, or 20% of program revenue. By 2030, costs rise to $1.35 million or 18% of program revenue. By 2040, costs rise to $4.16 million or 16% of program revenue.

Operating scenario 5. In this scenario we assume a flat fee equal to 150% of the average MBUF amount paid, which leads 83% of drivers to choose the MBUF option. We assume the state only offers only automated reporting through commercial account managers. Further, we assume the state covers only $30 per year to cover the cost of automated mileage reporting, allowing the commercial vendor to charge customers directly to recover additional costs.

Cost factor	Assumption
Flat fee amount	150% the average value paid in MBUF, or $209 per year
% choosing MBUF	83% choose MBUF over flat fee
MBUF paradigm	CAM model
% choosing odometer MBUF	0%
Automated annual cost	$30 covered by the state

Based on these assumptions, the cost to operate the flat fee/MBUF program in year 1 is about $483k, or 27% of program revenue. By 2030, costs rise to $2.04 million or 25% of program revenue. By 2040, costs rise to $6.57 million or 22% of program revenue

As the operating scenarios illustrate, the major driving cost is the number of vehicles choosing automated reporting. The more vehicles that choose MBUF and, in turn, choose automated reporting, and the more of that cost covered by the state, the higher the cost to the state. The more that vehicles opt for odometer reporting or the flat fee option, the lower the cost.

7 Future system needs

Synopsis

A state MBUF system in Vermont will need to consider issues which will arise in the future.

Interoperability. States with MBUF will need to enter into interoperability agreements so that vehicle owners driving across state borders can experience similar mileage reporting requirements.

Native automaker telematics. As location data becomes available on such systems, states may want to support them, so account managers should be encouraged to integrate with automakers directly, or via third-party services.

Transition to all vehicles. Transitioning all vehicles from fuel taxes to MBUF requires examination of technical, revenue and political risks. A sudden transition magnifies these risks, while a gradual transition softens them.

Commercial fleets. Having different needs, commercial fleets need the ability to enroll and withdraw vehicles frequently and easily.

Future Decisions

1. Should Vermont support interoperability with other states' MBUF systems?
2. Should Vermont seek to integrate native automaker telematics into an MBUF program?
3. Should Vermont seek to transition its MBUF program beyond electric vehicles and plug-in electric vehicles to a larger fleet of vehicles over time?

This section discusses the following potential future system needs:

7.1 Regional/national interoperability
7.2 Integration of native automaker telematics
7.3 Potential for transition to MBUF for all vehicles
7.4 Operational needs for a future with commercial fleets
7.5 Inclusion of heavy vehicles

7.1 Regional/national interoperability

As MBUF systems are more widely deployed throughout the country in the coming years, there will be a need for state MBUF systems to interoperate. As they drive across state borders, vehicle owners will want to be able to use the same mileage reporting technology to pay for MBUF in all states. To support interoperability, states will need to make interoperability agreements and exchange data on miles driven and MBUF paid. Regions may choose to create interoperability hubs—clearinghouses that balance miles reported and MBUF owed among states participating in the clearinghouses.

7.2 Integration of native automaker telematics

As indicated above, automakers are not currently supporting telematics directly, and the third-party service providers that support native automaker telematics do not support detailed provision of location data. As location data becomes available on such systems, state systems may want to begin supporting them, so account managers should be encouraged to integrate with automakers directly, or via third-party services. Integration will involve developing an API and business agreement.

7.3 Potential for transition to MBUF for all vehicles

MBUF may start as an alternative to a flat fee and may only apply to a small subset of vehicles, such as electric vehicles, but as fuel tax revenues continue to erode, states may wish to transition many or all vehicles to paying MBUF instead of the fuel tax. The transition may be reinforced if electric vehicles become dominate. States that have implemented MBUF as an alternative to a flat fee generally do not intend for that to be the revenue policy for the long term (i.e., more than 10 years). Rather, such states intend to transition entirely to an MBUF program, with an MBUF instead of fuel taxes for most vehicles (although the high flat fee option, in which drivers do not pay an MBUF, may remain).

In general, a sudden transition—one involving most or all vehicles transitioning in a relatively short period of time (such as a year)—carries technical, revenue, and political risks and may involve many vehicle owners having a poor experience. A gradual transition—such as transitioning most or all of the fleet over a longer period (10 years) is more likely to succeed. The fossil fuel consuming vehicle fleet can be phased in each year based on vehicle's model

year (e.g., start with new vehicles, then add all vehicles produced in the last 3 years, then all vehicles in the last 5 years, etc.). Or it can be phased in based on a vehicle's fuel consumption (e.g., first include 50 mpg + vehicles, then 45 mpg+ vehicles, then 40 mpg+ vehicles, etc.). Even more gradual transitions have been proposed, such as simply applying MBUF to new vehicles only, starting in a future year. Ultimately, a 10-year transition of the entire fleet to MBUF is feasible without major risks, while a 1-year transition is quite risky.

If all light vehicles pay the same per-mile MBUF rate, then vehicles that get lower fuel economy than a certain threshold value will actually pay less under an MBUF than they would have under the fuel tax. The state may wish to leave these vehicles on the fuel tax for an extended time.

Fuel taxes and MBUF may coexist for some period of time. When this occurs, if the MBUF is intended to replace (not supplement) the fuel tax, fuel taxes paid can be credited or refunded to MBUF payers, based either on a measure of fuel used, or an estimate computed from a vehicle's average mpg.

7.4 Operational needs for a future with commercial fleets

Commercial fleets have different needs than private vehicle owners. Commercial fleets need to be able to enroll and withdraw vehicles frequently, and to enroll large number of vehicles at a single time. To support these vehicles, one or more account managers should offer a fleet-optimized account.

Autonomous and ridesharing vehicles may include technology that generates data usable for MBUF reporting. One or more CAMs may be needed to focus on such fleets, to support the provision of mileage data from their native technologies.

7.5 Inclusion of heavy vehicles

Heavy vehicles are also electrifying. Freightliner expects to release a fully electric semi tractor-trailer in December 2022. At some point, the state may wish to consider including heavy vehicles in the MBUF program. Heavy vehicles tend to cause more damage to the roadway than lighter vehicles, so the state may wish to consider setting rates appropriate for such vehicles.

Heavy vehicles are best served by different technologies than those used in light vehicles for MBUF. Interstate heavy vehicles are required to include in-vehicle electronic logging devices, which record miles driven and hours worked for drivers. Lower-end electronic logging devices may not be sufficiently secure or accurate to provide data for use in MBUF programs, but higher end electronic logging devices are secure and accurate and can be used for MBUF programs. A more sophisticated technology, the fleet management system, which many interstate carriers use, is certainly sufficiently secure and accurate for use in MBUF systems.

8 Recommendations

Synopsis

The project team makes the following recommendations:

1. Begin with a small program for EVs whereby vehicle owners choose between flat fee or MBUF.
2. Use vehicle inspection odometer records as a basis for MBUF for most vehicles.
3. Use self-reporting or odometer image capture to get odometer records in cases of vehicles exiting the state or leaving the program.
4. If enough Vermonters show interest in a location-based reporting, eventually include a CAM offering location-based reporting (such as OBD-II devices) for vehicles that do not want to pay for out-of-state or off-road miles driven.
5. If a CAM is used, employ an open system for a CAM (open standards and specifications) from the start, and when the market is large enough to support multiple CAMs, an open market.
6. Include privacy protection and enforcement provisions in MBUF law.
7. Consider program expansion after launch and evaluation.

Decisions

Does the advisory committee support these recommendations?
What modifications to these recommendations can attract support?
Are there other decisions that can attract support?

The project team makes the following recommendations for Vermont:

Short-Term Recommendations

1. **Begin with a small, flat fee/MBUF alternative program**—start an MBUF system with a program that impacts only a relatively small number of vehicles, such as electric vehicles, which are not paying the fuel tax. Offer the MBUF program on a voluntary basis, in lieu of paying a flat fee.
2. **Use vehicle inspection odometer records as a basis for MBUF for most vehicles**. As Vermont already has odometer records, it should take advantage of them. MBUF charges can be computed directly from such records
3. **Use self-reporting or odometer image capture to get odometer records in cases of vehicles exiting the state or leaving the program**. When vehicles exit the MBUF program, it

will likely not be immediately following a vehicle inspection. To cover these miles, the state should employ odometer image capture, or simply self-reporting.

Longer-Term Recommendations

4. **If enough Vermonters show interest in a location-based reporting, the MBUF program should eventually include a CAM with OBDII devices for vehicles that do not want to pay for out-of-state or off-road miles driven, though this service need not be in place when the system starts or for early years of system operation**. When such services are offered, the state may require vehicle owners using this CAM to pay for these services. CAM services can operate as an open market, but to begin, CAMs may need to be compensated by the state for their services.
5. **If a CAM is used, employ an open system for a CAM (open specifications) from the start, and when the market is large enough to support multiple CAMs, an open market.** Any CAM should be procured based on openly available specifications and be required to recompete for its contract with some frequency, e.g., every 3 or 5 years. If the number of vehicles registered to a CAM exceeds some value (say, 100,000 vehicles), the state should consider offering an open market for CAMs, in which any interested CAM can offer its services in the state after being certified.
6. **Include privacy protection and enforcement provisions in any law creating an MBUF.** Ensure that location data is destroyed after a certain time, and that data cannot be sold, or used in any way that is not fully anonymized, without the owner's consent. Ensure that the state government has authority to distribute penalty fines in cases of unpaid RUC, and in severe cases, can issue registration holds for a vehicle.
7. **Consider program expansion after launch and evaluation**. Once the program has been launched for a relatively small number of vehicles, it should be evaluated and improved. After that, it can be expanded to include other vehicles.

8.1 Steps after MBUF/Flat Fee system design choices

This memo provides initial guidance to help the state make initial policy and system design choices. Following the state's initial policy and system choices for a flat fee/MBUF system, system design typically involves the following steps:

1. Creating a high-level design document, generally called the *Concept of Operations*. This document should be readable by people without specialized system knowledge, describing the need and context for the system, and the ways in which the system can be used, both by MBUF/flat fee payers and by the state. Development of a concept of operations is an early part of the systems engineering process.

2. Development of detailed design documents: system requirements, which explain the technical details of the concept of operations; business rules, which explain all business-

related behaviors of the system; and interface control documents, which explain the technical details of all system interfaces.

3. Determining procurement approach, including developing procurement strategy (of having one or many account managers) and writing procurement documents, such as an RFP. In the case an existing system has to be enhanced to support administration of a flat fee/MBUF, a light-touch procurement approach for a system upgrade could be implemented.